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(71) Applicant(s)
The Pen Corporation Ltd

(Incorporated in the United Kingdom)

Mill Mead, STAINES, Middlesex, TW18 4UQ, United Kingdom

(72) Inventor(s)
Philip Crieghton
George Kealy
Terry Miles
Trevor Batty

(74) Agent and/or Address for Service
George Kealy
Pear Tree Cottage, Lymore Lane, KEYHAVEN, Hants, SO41 0TS, United Kingdom

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US 4513437 A US 4491688 A US 3986403 A

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UK CL (Edition L) B6P PAA , F2Y YTA YTB , G1N NAGA10 NAQB
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(54) Computer input pen.

(57) A computer pen that does not require any reference point to be touched or active matrix or the interruption of a field to know its present positioning. It is fitted with a standard retractable pen refill (51). It can be used for normal screen cursor control with or without reference to a substrate, can be used as a digitiser without reference to a tablet, can be used as a writing or drawing implement on any normal writing surface, and concurrently send back positional X and Y co-ordinate information through circuitry and microprocessors (56) to the computer via a cable (55) to give an accurate representation of the writing or drawing. Its absolute positioning is derived without recourse to a spatial frame of reference through the use of peizo ceramic bimorphic bender sensors (50) and Hall effect and rotational sensors (59) housed in the top and bottom of the pen body (52).

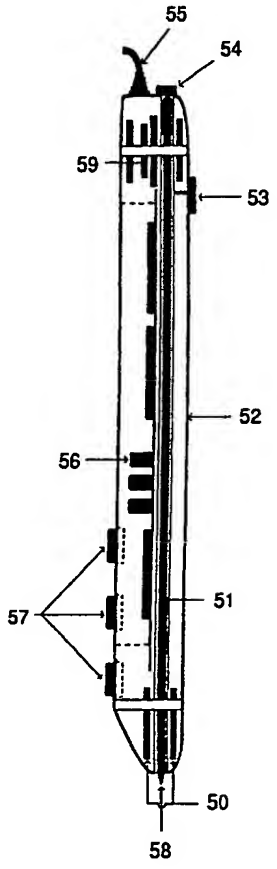

Figure 4

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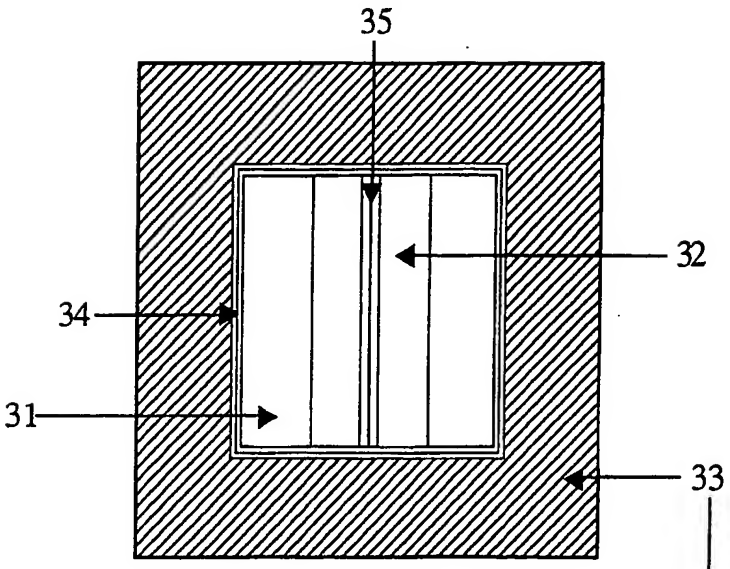

Figure 1

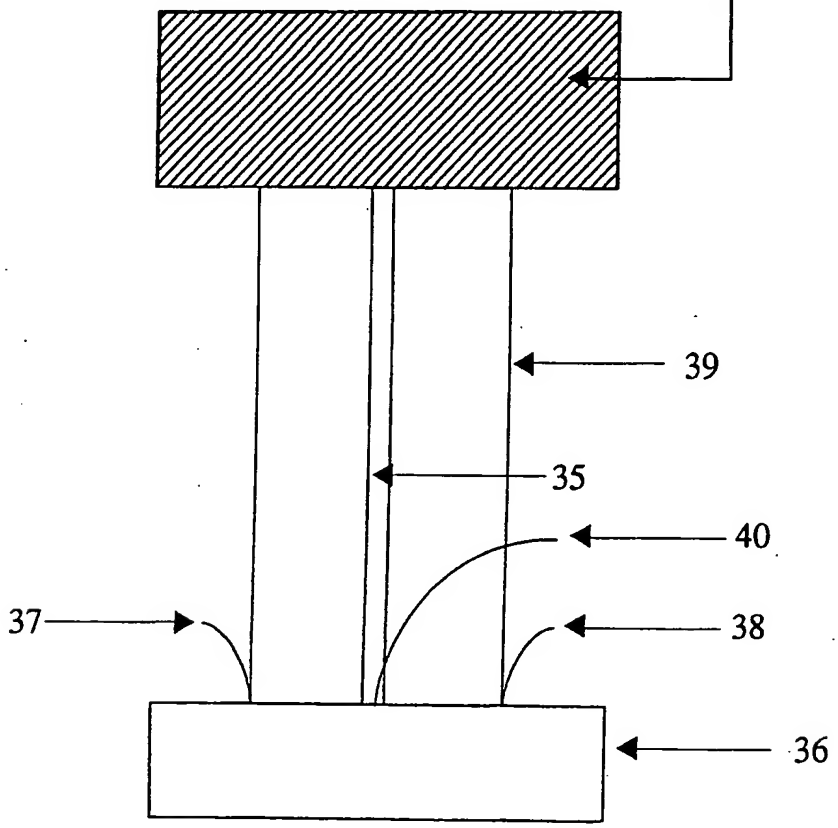

Figure 2

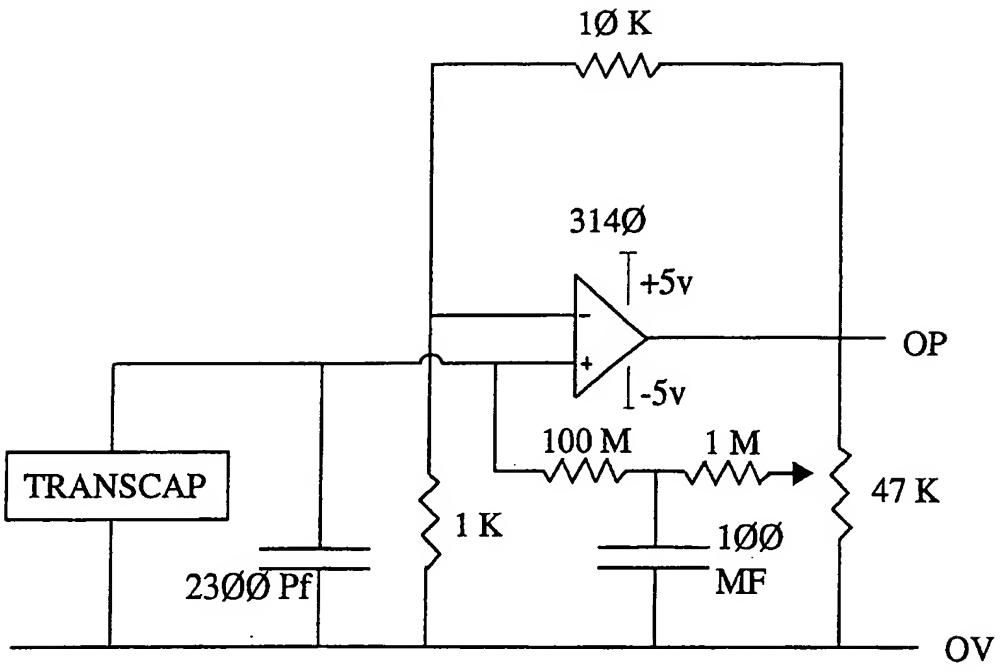

Figure 3

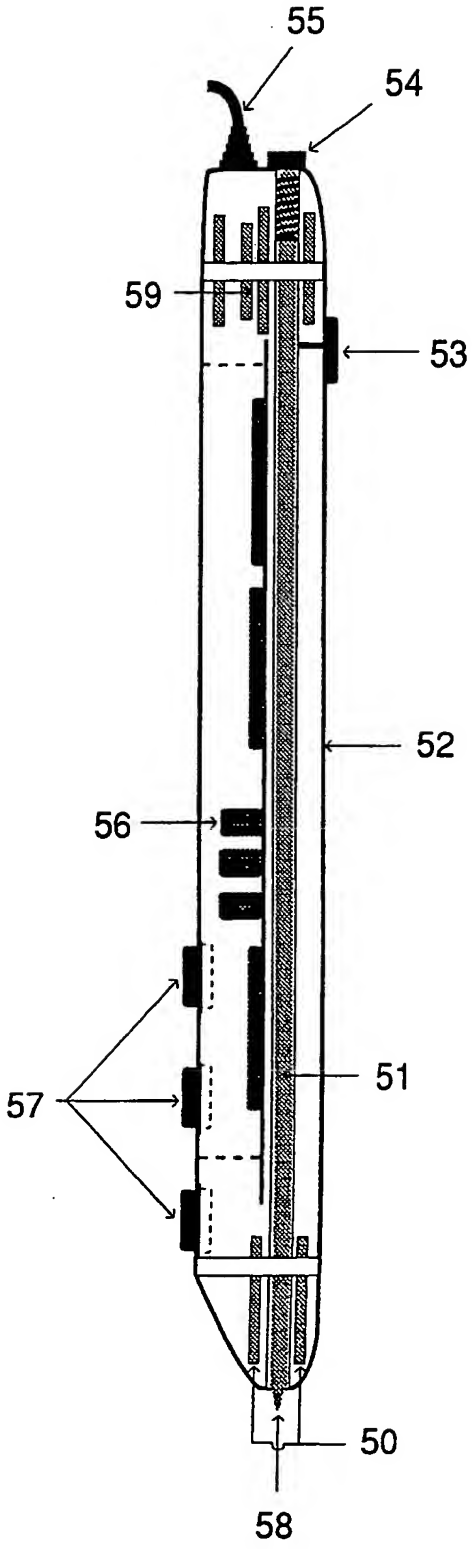

Figure 4

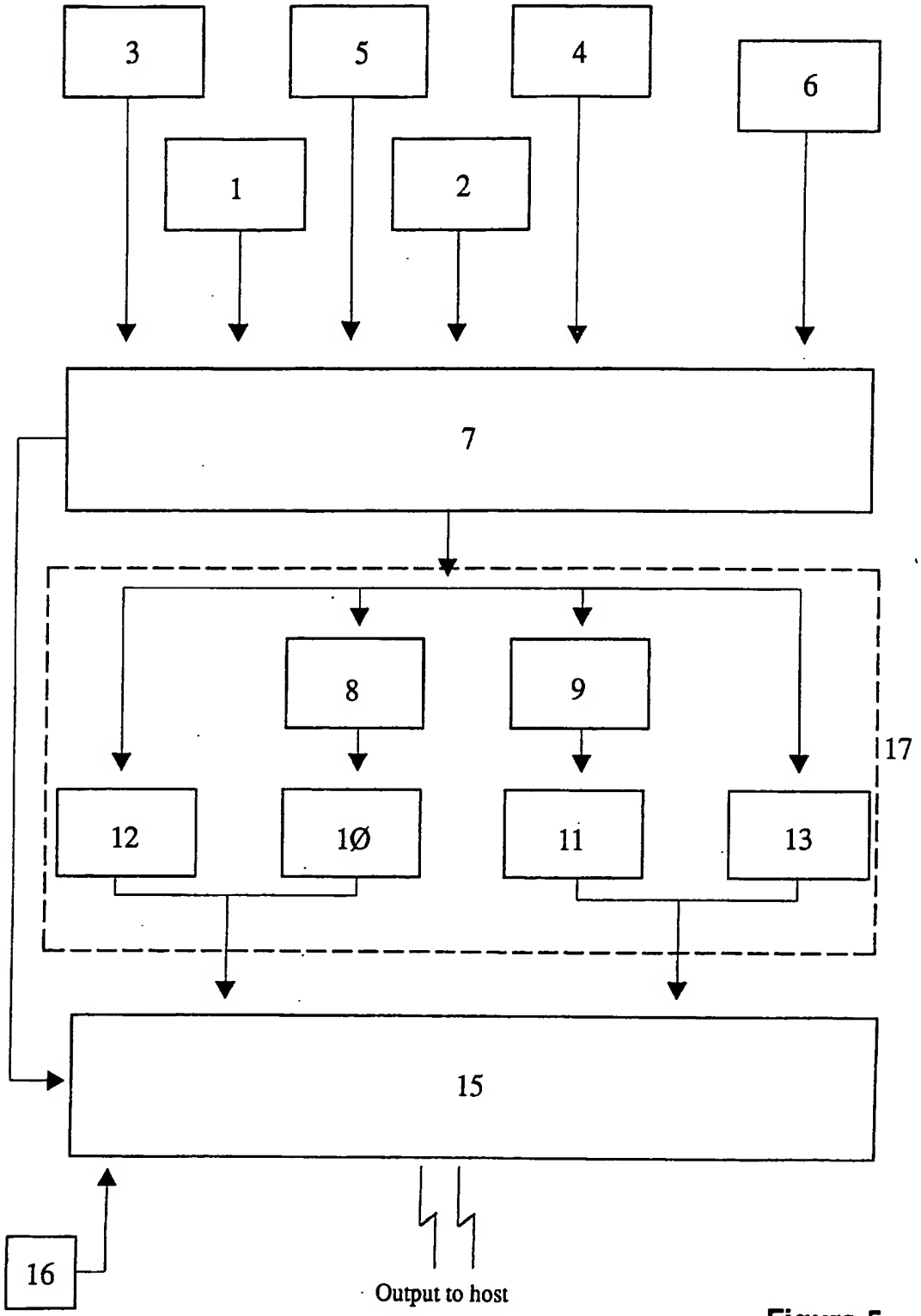

Figure 5

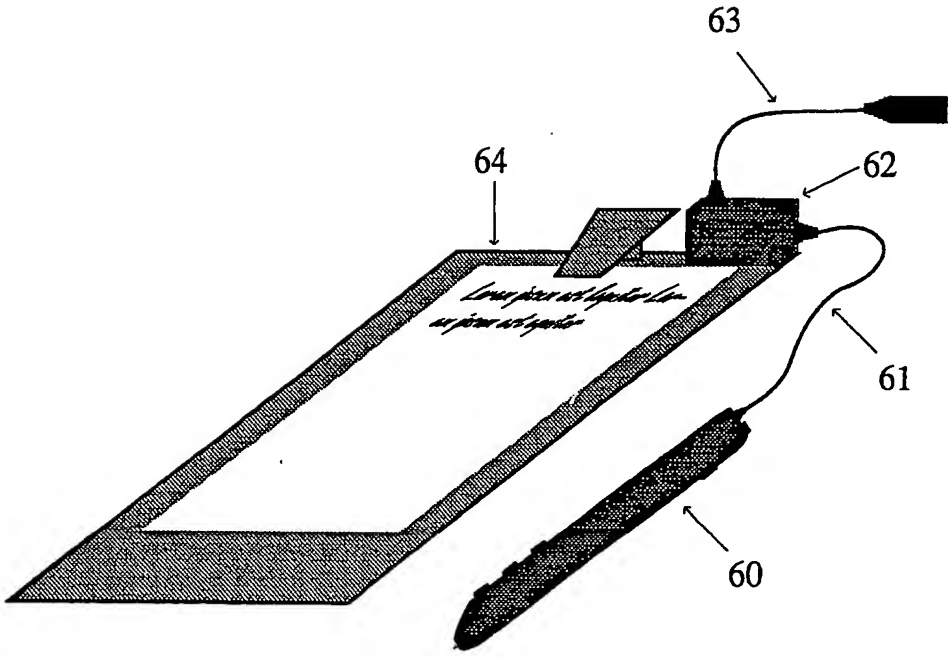

Figure 6

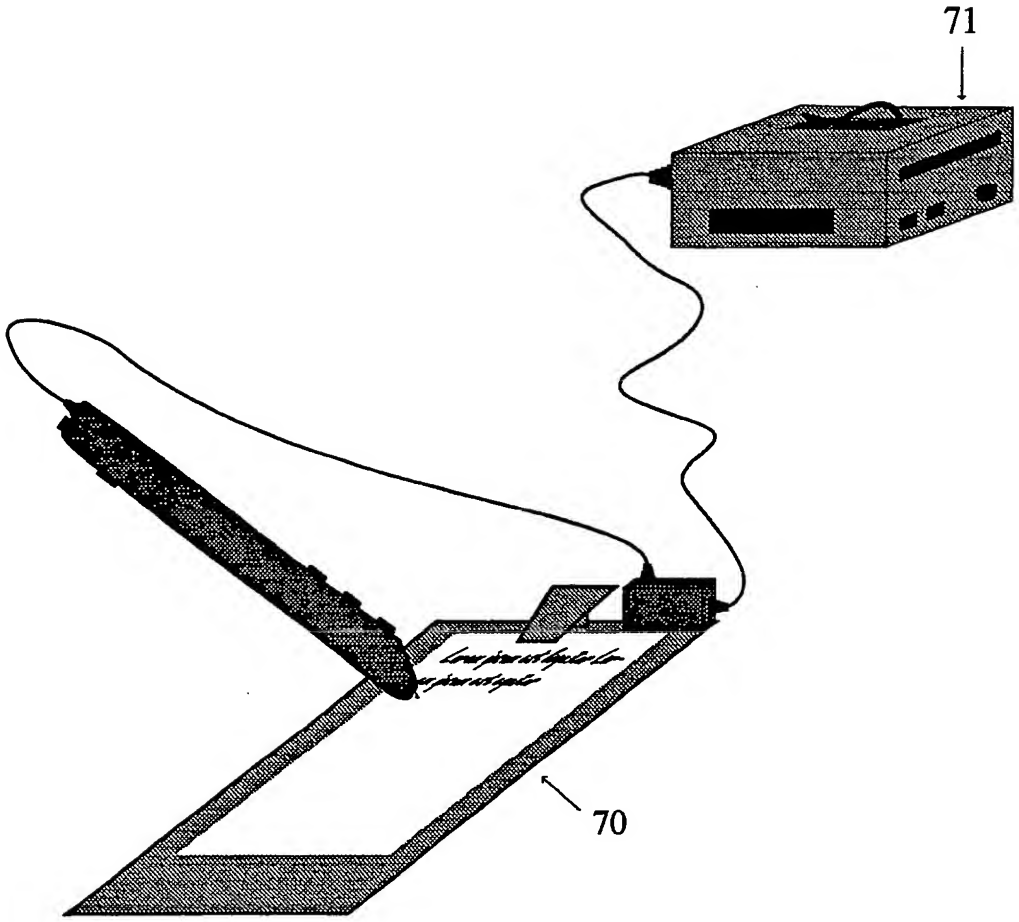

Figure 7

COMPUTER PEN

This invention relates to the capture of drawing of shapes, handwriting, notation, with a writing pen apparatus in conjunction with a computer.

Background

With the present stage of computer technology reducing the size of personal computers to small lightweight and mobile devices and with the up-and-coming technology of hand writing recognition mobile methods of entry of handwriting, drawing are limited.

The most common forms of devices that carry out these functions are:-

The "mouse" - a device that utilises a ball or wheels to operate optical/ mechanical sensors or potentiometers to track the distance travelled over a substrate. This in turn passes back the distance and direction travelled to the computer in the points of movement and direction of both the X and Y planes. When the ball or wheels are not in contact with the substrate positioning information is lost. This device is not conducive to use in a mobile situation.

The "digitiser" tablet - there are two basic forms of digitiser tablet. These are based on either "sonic" or "capacitative" technology. "Sonic" technology utilises a frequency when the pointer touches the tablet that is detected by a pair of microphones coupled with a time differential between the two signals received designating the present X and Y co-ordinates on the tablet. "Capacitative" technology is dependant on an active matrix within the tablet structure that is interactive with an active pointing device. When the two active devices form a circuit the present X and Y co-ordinates are known. Both these and other tablet technologies pass back a pair of co-ordinates to the computer based on a 0,0 origin on the tablet. This is not a portable device.

The "screen pen" - this is generally a screen with a perimeter that generates some form of field with an active pen. When the pen interrupts the field the present X and Y co-ordinates are known within the screen's field matrix. This form of technology is mobile, however it is a purpose-built computer and pen system and will not operate on existing computers that were not designed with this facility.

In all these cited cases the present positioning information is only known by a physical touching of two elements or the breaking of a field to produce the X and Y co-ordinates of travel.

In accordance with this invention it does not require any reference point to be touched or active matrix or the interruption of a field to know its present positioning. The apparatus can be used as a normal mouse for screen cursor control with or without reference to a substrate. The apparatus can be used as a digitiser without reference to a tablet. The apparatus can be used as a writing or drawing implement on any normal writing surface and concurrently send back positional X and Y co-ordinate information to the computer to give an accurate representation of the writing or drawing. The apparatus' absolute positioning is derived without recourse to a spatial frame of reference. The positioning is derived by the recording of the inertial force of the apparatus when moved and then obtaining the velocity from a single integration on the acceleration signal. This provides a constant directional movement stream of positional information in both the X and Y planes since the last positional sample was made via timing from a clock.

This invention consists of a purposely constructed low cost peizo-electric sensor capable of deformation internally to movement generating a voltage on a linear scale relating to the acceleration of the apparatus.

The signal received is processed and the velocity is calculated which in turn produces points of movement and direction of travel. Further provided is a pressure detector that produces an independent scaled signal stating whether the apparatus is in contact with a substrate and the degree of pressure being applied at any given time.

In all writing the pen moves in both the X and Y direction but is also subject to forces of gravitation by tilting and rotation of the pen around its axis. A further sensor bank of Hall Effect sensors is positioned within the pen shaft. These sensors concurrently monitor the earth's magnetic field for changes in the flux corresponding to the change of the angle from the vertical. This provides a correction signal that is the same as the gravitational components in the acceleration signal which is the unwanted by-product of tilting the pen. Further sensors are provided to counter the unwanted signals due to rotation.

The apparatus is also capable of being loaded with an ink or other marking substance in a cartridge or a pointing stylus. The barrel of the apparatus contains buttons that generate signals when pressed which are concurrent with all other signals to show the current status of each button.

A further development of the pen device is a version without a connecting cable to the host computer. The positional and directional information is transmitted by low power radio frequency to a purpose built receiver board in-situ in the host computer's expansion bus cage. This form of information transmission is also valid for the mobile storage device.

Fig. 1 is a plan view of the transcap sensor.

Fig. 2 is a side elevation of the transcap sensor.

Fig. 3 is the transcap in situ with buffer and amplification stage.

Fig. 4 is a wire connected pen casing and component sighting.

Fig. 5 is a flow chart of signal processing.

Fig. 6 is a diagrammatic view of the motion box for mobile compensating pen and writing pad holder.

Fig. 7 is a diagrammatic view of the data box for temporary storage of handwriting for transfer to a main computer for processing.

Fig. 1 shows a plan view of the transcap sensor. The transcap is constructed of two bi-morphic benders (31) and (32) of peizo ceramic material bonded to both sides of a brass vein. The flexing of the vein generates a linear voltage output proportional to the flex applied. They are separated by a copper shim (35) to ensure an even contact between the bi-morphic benders. Two benders are used to automatically compensate for temperature change in normal circumstances. A weight (33) is crimped to the top of the bi-morphic benders to improve sensitivity and signal-to-noise ratio. An insulation sleeve (34) is wrapped around the bi-morphic benders to ensure that shorting does not occur.

Fig. 2 shows a side elevation of the transcap. The weight (33) is mounted on the end of the bi-morphic benders (39). These are mounted in a rubber base block (36) to damp unrequired vibration elements that would produce false signals. Two connectors (37) and (38) are provided to read the output signals of each vein and a connector (40) to provide reference values of both veins. Given these values a temperature compensated signal can be given.

Fig. 3 is a diagram of the transcap sensor in situ coupled to buffer and amplification circuitry.

Fig. 4 is a diagram of the device. The device is held in the normal manner of a standard pen with the point (58) used for writing or drawing. The pen case (52) has a standard pen refill (51) which is used to mark as a normal pen device. The refill is loaded into the case through

the opening (54) and can be retracted by a spring-loaded slider (53). The refill (51) can be substituted with a plastic stylus. As the pen is moved the two transcap sensors (50) which are orthogonally mounted generate a voltage by being flexed by the inertia. This is continually sampled and passed to the circuitry (56) mounted within the shaft of the pen for processing. A bank of Hall Effect and rotational sensors (59) mounted in the rear of the pen monitor tilt and rotation which is also passed to the central circuitry (56) for signal compensation. The output of this circuitry is a stream of points of movement within a given time period and direction of travel that was made in both the X and Y directions. This is packaged into a byte stream and transmitted to a host computer system via a cable (55) mounted on the base of the pen. Concurrent to this process a signal is generated on a sliding scale on the pressure placed on the pen point. This signals to application software whether to generate an image of the movement of white space such as those separating letters within a word. This is also transmitted to the host within the byte package. Further information is generated from three buttons (57) mounted externally on the pen shaft on whether the contacts are open or closed during the period of sampling of the transcap sensors. This too is packaged and passed to the host computer as before described.

Fig. 5 is a visual representation of the signal processing. Movement of the device produces signals generated in varying voltage form from the X and Y transcap sensors (1) and (2). Further movement signals are generated from the upper pen sensors (3) and (4) to record additional gravitational inertia generated through pen tilting. Additional rotational inertia is generated from transcap (5). All these signals are funnelled through a multiplexor (7) and concurrently converted from analog to digital form. Device tilt (3) and (4) and rotation signals (5) are deducted from the signals produced by (1) and (2), and by (8) and (9), to give a stable signal of interest for both the X and Y movements. These signals are passed and integrated to (10) and (11) which produces an output of the velocity and direction of travel for both the X and Y. Device movement is detected by (12) and (13) which when not active inhibits output and ensures reset stability of the integrators (10) and (11). The whole process as designated (17) within the dotted lines is performed within a reduced instruction set processor with on board ROM and RAM. The output is passed to another reduced instruction set processor (15) for package into a byte stream for passing to a host computer, and it is also capable of transmitting to the host computer an embedded non-erasable serial number by the receipt of an enabling signal from the host computer. Concurrently pen point pressure signals are registered on (6) and passed to (15), and the status of the buttons (16) are registered (open or closed) and also passed to (15) for final packaging.

Fig. 6 is a visual impression of the mobile version of the device. It consists of a pen device (60) all as before described in Figs 1 - 5 connected by a cable (61). The cable is connected to an alternate set of circuitry (62). This set of circuitry is a duplicate of that in the pen device. This monitors the movement of the pad (64) as the movement of the pen (60) is monitored by its own internal circuitry. Both sets of signals are compared and the unwanted movement of the board are deducted to leave the pen movement which is passed to the host by cable (63).

Fig. 7 is a visual representation of the mobile device as shown in Fig. 6 coupled to a storage local device. This storage device (71) contains either magnetic disk, flash card or other form of non-volatile storage complete with its own microprocessor, random access memory and limited control program to store the image of the pen movements over the pad (70). Provision is made within the storage device for a communication port to transmit the stored images in page form from the device to a host computer.

CLAIMS

1. An apparatus in the shape of a pen;

   that whilst in contact with a substrate for writing or drawing or otherwise making a mark simultaneously transmits positional information by means of a cable to an input/output port on a computer for recording of that same information for screen manipulation and/or storage.

   that transmits information to a computer of its present position when not in contact with a substrate.

   that can be used as a computer pointing apparatus.

2. The apparatus according to Claim 1 further comprising of;

   a mobile writing surface connecting the pen cable to duplicate circuitry as constructed within the pen mounted on the writing surface to measure the movement of the writing surface. This is coupled to additional circuitry to deduct the difference in the writing surface movements from those made by the pen in its required actions of writing or drawing or otherwise making a mark to produce the pen movements only.

3. The apparatus according to Claim 1 and 2 further comprising of;

   a miniature magnetic disk storage or flash card device with allied circuitry and software control which is connected to the pen for temporary storage of the actions of writing or drawing or otherwise making a mark by the pen for later transmission to a host computer.

4. The apparatus according to Claim 1 and 2 and 3;

   that is battery powered and transmits positional information to a computer or storage device without the use of a cable but by low power radio frequency transmission from the pen to a purposely constructed receiver board that is inserted in the computer's or storage device's bus expansion cage.

5. The apparatus according to Claim 1 and 2 and 3 and 4;

   that contains an embedded non-erasable serial number that can be read by a host computer for security purposes by transmission of an enabling code sent from the host computer.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9303312.4
Relevant Technical Fields (i) UK Cl (Ed.L) B6P (PAA); F2Y (YTA, TYB); G1N (NAGA10, NAQB) (ii) Int Cl (Ed.5) B43K 29/00, 29/08; G06F 3/033; G06K 11/18	Search Examiner J L TWIN Date of completion of Search 25 OCTOBER 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASE : WPI	Documents considered relevant following a search in respect of Claims :- 1-5

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X,E	EP 507269 A2	(YASHIMA ELECTRIC) - see eg column 11, lines 30-40	1
X	EP 413606 A2	(MATSUSHITA) - see eg column 6, line 55 to column 8 line 51	1
X	WO 88/02895 A1	(TYBAR ENGINEERING) - see eg the abstract	1
X	US 4513437	(CHAINER et al) - see eg column 3, lines 17-45	1
A	US 4491688	(SCHAUB) - see eg column 1, lines 11-17	1
X	US 3986403	(HURD et al) - see eg column 6, lines 40-64	1

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